

# FSA2156 Low-Voltage SPST 0.4Ω Analog Switch

## Features

- Maximum 0.7Ω ON resistance ( $R_{ON}$ ) for +2.7V supply
- 0.25Ω max  $R_{ON}$  flatness for +2.7V supply
- Space-saving Pb-free MicroPak™ and SC70 packaging
- Broad Vcc operating range: 1.65 to 4.3V
- Fast turn-on and turn-off times
- Over-voltage tolerant TTL-compatible control input
- Suitable for 2 UL USB2.0 applications (200mA)
- Low  $I_{CCT}$  current over an expanded control input range

## Description

The FSA2156 is a high-performance Single-Pole Single-Throw (SPST) analog switch that features ultra low  $R_{ON}$  of 0.4Ω (typ.) at 2.7V  $V_{CC}$ . The FSA2156 operates over the wide VCC range of 1.65V to 4.3V and is fabricated with sub-micron CMOS technology to achieve fast switching speeds. The select input is TTL-level compatible.

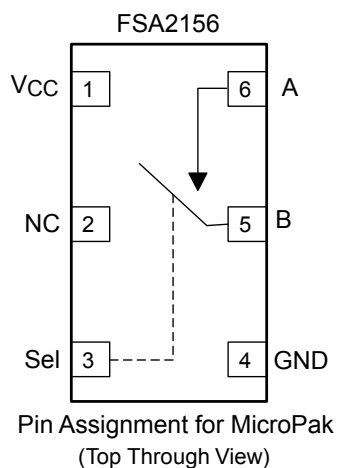
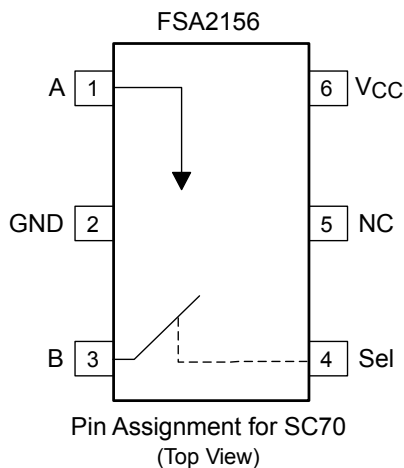
FSA2156 features very low quiescent current even when the control voltage is lower than the VCC supply. This feature facilitates longer battery life in mobile handset applications and allows for the direct interface with baseband-processor, general-purpose I/Os.

## Ordering Information

Part Number	Product Code Top Mark	Package Number	Pb-Free	Package Description	Packing Method
FSA2156P6	2156	MAA06A	Yes	6-lead SC70, EIAJ SC88, 1.25mm Wide	250 Units on Tape and Reel
FSA2156P6X	2156	MAA06A	Yes	6-lead SC70, EIAJ SC88, 1.25mm Wide	3k Units on Tape and Reel
FSA2156L6X	FY	MAC06A	Yes	6-lead MicroPak, 1.0mm Wide	5k Units on Tape and Reel

Pb-free package per JEDEC J-STD-020B.

## Analog Symbol



Truth Table	
Control Input (S)	Function
L (LOW Logic Level)	Switch Open (OFF)
H (HIGH Logic Level)	Switch Closed (ON)

Pin Descriptions	
Name	Function
A, B	Switch I/O Data Ports
Sel	Control Input

### Absolute Maximum Ratings<sup>(1)</sup>

The “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The “Recommended Operating Conditions” table defines the conditions for actual device operation.

Symbol	Parameter	Min.	Max.	Unit
V <sub>CC</sub>	Supply Voltage	-0.5V	4.6V	V
V <sub>SW</sub>	Switch I/O Voltage <sup>(2)</sup>	-0.5V	V <sub>CC</sub> + 0.3V	V
V <sub>CNTRL</sub>	Control Input Voltage <sup>(2)</sup>	-0.5V	4.6V	V
Input Clamp Diode Current	Input Clamp Diode Current	± 50mA	± 50mA	mA
Switch I/O Current (continuous)	Switch I/O Current (continuous)		500mA	mA
Peak Switch Current	Pulsed at 1mS Duration, <10% Duty Cycle		500mA	mA
Power Dissipation @ 85°C	SC70 6L Package		180mW	mW
	MicroPak 6L Package		180mW	mW
T <sub>STG</sub>	Storage Temperature Range	-65°C	+150°C	°C
T <sub>J</sub>	Maximum Junction Temperature		+150°C	°C
T <sub>L</sub>	Lead Temperature (Soldering, 10 seconds)		+260°C	°C
ESD Human Body Model	All Pins		2kV	kV
	I/O to GND		8kV	kV
	Charge Discharge Model		2kV	kV

#### Notes

1. Absolute maximum ratings are DC values for which the device may be damaged or have its useful life impaired. The data sheet specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and input/output loading variables. Fairchild does not recommend operation outside datasheet specifications.
2. The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.

### Recommended Operating Conditions<sup>(3)</sup>

Symbol	Parameter	Min.	Max.	Unit
V <sub>CC</sub>	Supply Voltage	1.65V	4.3V	V
V <sub>CNTRL</sub>	Control Input Voltage <sup>(4)</sup>	0V	V <sub>CC</sub>	V
V <sub>SW</sub>	Switch I/O Voltage	0V	V <sub>CC</sub>	V
Switch I/O Load Current	Switch I/O Load Current		350mA	mA
Operating Temperature	Operating Temperature	-40°C	85°C	°C
Thermal Resistance $\theta_{JA}$ (free air)	SC70 6L package		350 °C/W	°C/W
	MicroPak 6L package		310 °C/W	°C/W

3. Recommended Operating conditions are specified to ensure optimal performance to the datasheet specifications. It is recommended not to exceed them or design to absolute maximum ratings.
4. Control input must be held HIGH or LOW; it must not float.

## DC Electrical Characteristics

All typical values are @25°C unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> =+25°C			T <sub>A</sub> =-40°C to +85°C		Units
				Min.	Typ.	Max.	Min.	Max.	
V <sub>IH</sub>	Input Voltage High		3.6 - 4.3				1.4		V
			2.7 - 3.6				1.3		
			2.3 - 2.7				1.1		
			1.65 - 1.95				0.9		
V <sub>IL</sub>	Input Voltage Low		3.6 - 4.3					0.7	V
			2.7 - 3.6					0.5	V
			2.3 - 2.7					0.4	
			1.65 - 1.95					0.4	
I <sub>IN</sub>	Control Input Leakage	V <sub>CNTRL</sub> = 0 to V <sub>CC</sub>	1.65 - 4.3				-0.5	0.5	μA
I <sub>NO(OFF)</sub>	OFF-Leakage Current of Port B	V <sub>A</sub> = 0.3V, V <sub>CC</sub> - 0.3V V <sub>B</sub> = 0.3V, V <sub>CC</sub> - 0.3V or Floating (Figure 2)	1.95 - 4.3	-10		10	-50	50	nA
I <sub>A(ON)</sub>	ON Leakage Current of Port A	V <sub>A</sub> = 0.3V, V <sub>CC</sub> - 0.3V V <sub>B</sub> = Floating (Figure 3)	1.95 - 4.3	-20		20	-100	100	nA
I <sub>OFF</sub>	Power Off Leakage Current	Port A V <sub>A</sub> = 0.3V, 4.3V, V <sub>CC</sub> =0V V <sub>B</sub> = 0V	0V					±25	μA
R <sub>ON</sub>	Switch ON Resistance <sup>(5)</sup>	I <sub>ON</sub> = 100mA, V <sub>B</sub> = 0V, 0.7V, 3.6V and 4.3V (Figure 1)	4.3		0.36			0.6	Ω
		I <sub>ON</sub> = 100mA, V <sub>B</sub> = 0V, 0.7V, 2.0V and 2.7V (Figure 1)	2.7		0.4		0.7		
		I <sub>ON</sub> = 100mA, V <sub>B</sub> = 0V, 0.7V, 1.6V and 2.3V (Figure 1)	2.3		0.55		0.8		
		I <sub>ON</sub> = 100mA, V <sub>B</sub> = 0.7V (Figure 1)	1.65		1.5				
R <sub>FLAT(ON)</sub>	ON Resistance Flatness <sup>(6)</sup>	I <sub>ON</sub> = 100mA, V <sub>B</sub> = 0V, 0.7V, 3.6V and 4.3V (Figure 1)	4.3					0.25	Ω
		I <sub>ON</sub> = 100mA, V <sub>B</sub> = 0V, 0.7V, 2.0V and 2.7V (Figure 1)	2.7				0.25		
		I <sub>ON</sub> = 100mA, B = 0V, 0.7V, 1.6V and 2.3V (Figure 1)	2.3				0.3		
		I <sub>ON</sub> = 100mA, V <sub>B</sub> = 0V, 0.7V, 0.9V and 1.65V (Figure 1)	1.65		0.9				
I <sub>CC</sub>	Quiescent Supply Current	V <sub>SW</sub> = 0 or V <sub>CC</sub> , I <sub>OUT</sub> =0	4.3	-100	30	100	-500	500	nA
I <sub>CCT</sub>	Increase in I <sub>CC</sub> per Input	V <sub>CNTRL</sub> = 2.6V	4.3		3			6.0	μA
		V <sub>CNTRL</sub> = 1.8V			7	12		15.0	

5. ON Resistance is determined by the voltage drop between A and B pins at the indicated current through the switch.

6. Flatness is defined as the difference between the maximum and minimum value of ON resistance over the specified range of conditions.

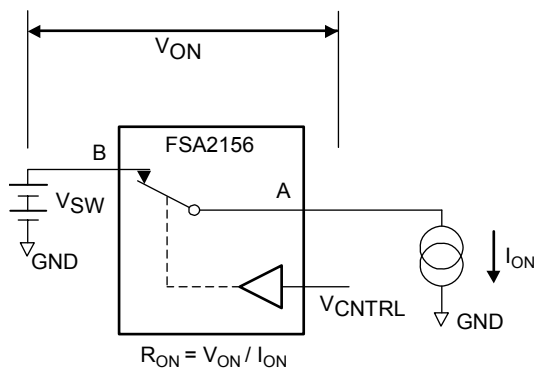
## AC Electrical Characteristics

All typical values are @25°C unless otherwise specified.

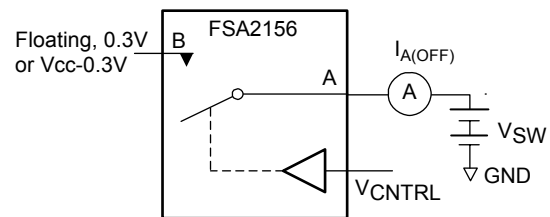
Symbol	Parameter	Conditions	Vcc (V)	T <sub>A</sub> =+25°C			T <sub>A</sub> =-40°C to +85°C		Units	Figure
				Min	Typ.	Max	Min	Max		
t <sub>ON</sub>	Turn-ON Time	V <sub>B</sub> = 1.5V, R <sub>L</sub> =50Ω, C <sub>L</sub> =35pF	3.6 - 4.3			55		60	ns	Figure 4 & 5
			2.7 - 3.6			60		65		
			2.3 - 2.7			65		70		
			1.65 - 1.95		40					
t <sub>OFF</sub>	Turn-OFF Time	V <sub>B</sub> = 1.5V, R <sub>L</sub> =50Ω, C <sub>L</sub> =35pF	3.6 - 4.3			65		70	ns	Figure 4 & 5
			2.7 - 3.6			70		75		
			2.3 - 2.7			75		80		
			1.65 - 1.95		90					
Q	Charge Injection	C <sub>L</sub> =1.0nF, V <sub>S</sub> =0V, R <sub>S</sub> =0Ω	2.3 - 4.3		6				pC	Figure 8
			1.65 - 1.95		1.3					
OIRR	OFF-Isolation	f=100kHz R <sub>T</sub> = 50Ω	1.65 - 4.3		-65				dB	Figure 7
BW	-3db Bandwidth	R <sub>T</sub> = 50Ω C <sub>L</sub> = 0pF	1.65 - 4.3		80				MHz	Figure 6
THD	Total Harmonic Distortion	R <sub>T</sub> = 600Ω, V <sub>SW</sub> = 0.5V P-P, f=20Hz to 20kHz	1.65 - 4.3		.02				%	

## Capacitance

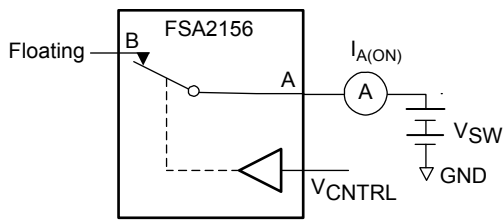
Symbol	Parameter	Conditions	Vcc (V)	T <sub>A</sub> =+25°C			T <sub>A</sub> =-40°C to +85°C		Units	Figures
				Min.	Typ.	Max.	Min.	Max.		
C <sub>IN</sub>	Control Pin Input Capacitance	f=1MHz	0		1.5				pF	Figure 9
C <sub>OFF</sub>	B-Port OFF Capacitance	f=1MHz	4.3		38				pF	Figure 9
C <sub>ON</sub>	A-Port ON Capacitance	f=1MHz	4.3		115				pF	Figure 10



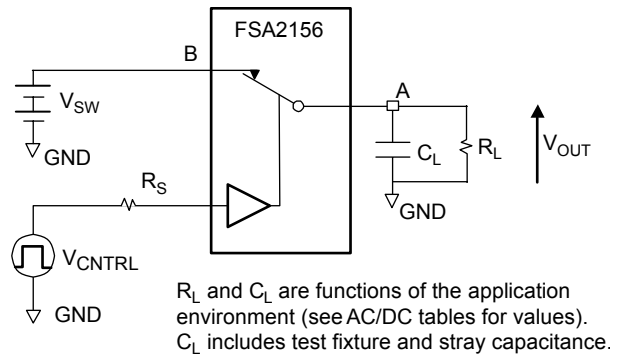
**Figure 1. On Resistance**



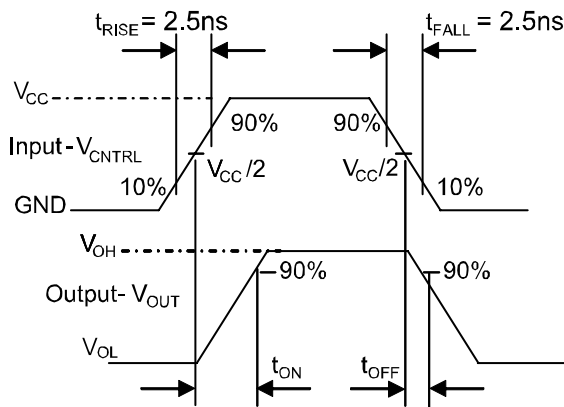
**Figure 2. OFF Leakage**



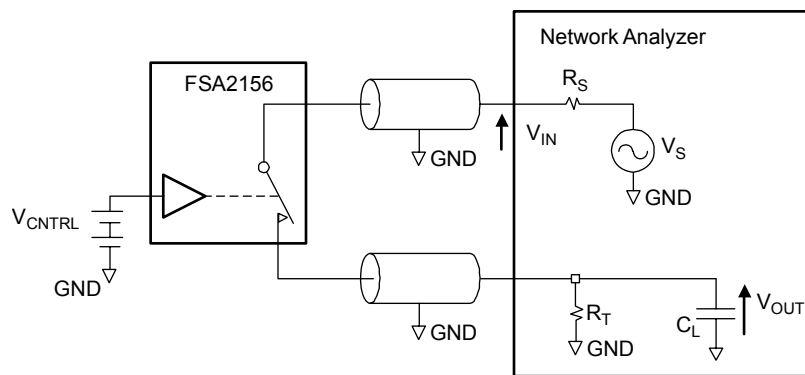
**Figure 3. ON Leakage**



**Figure 4. Test Circuit Load**

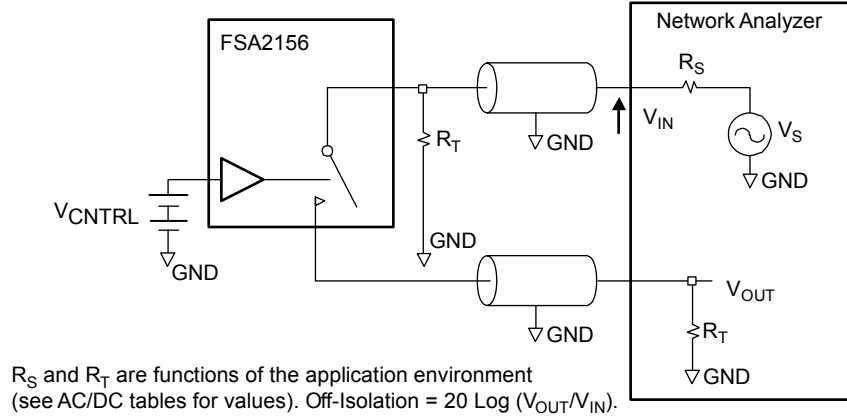


**Figure 5. Turn ON / Turn OFF Waveforms**

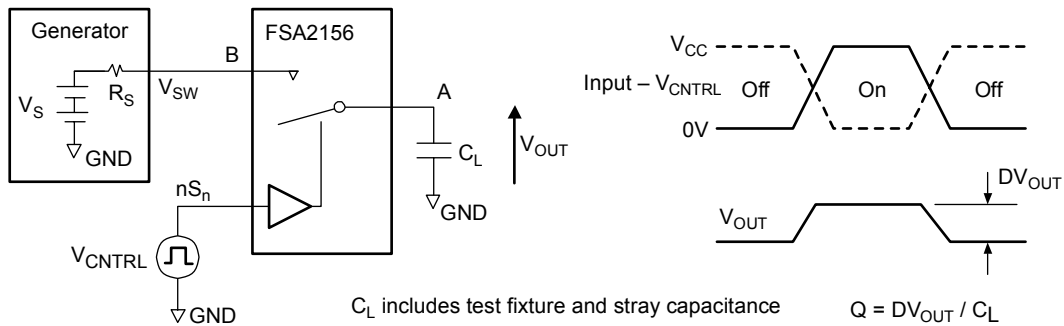


$R_T$  and  $C_L$  are functions of the application environment (see AC/DC tables for values).  $C_L$  includes test fixtures and stray capacitance.

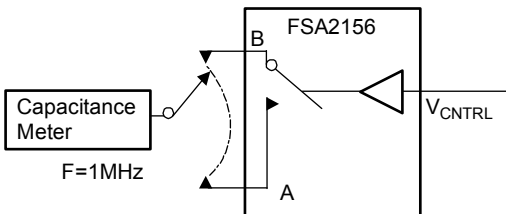
**Figure 6. Bandwidth**



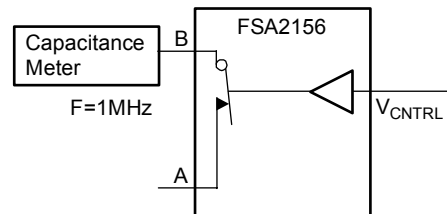
**Figure 7. Channel OFF Isolation**



**Figure 8. Charge Injection Test**



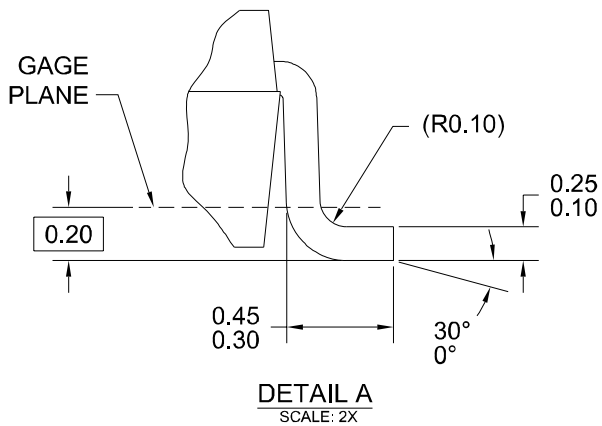
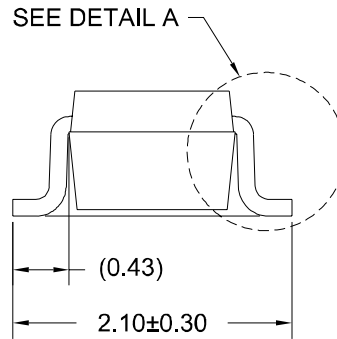
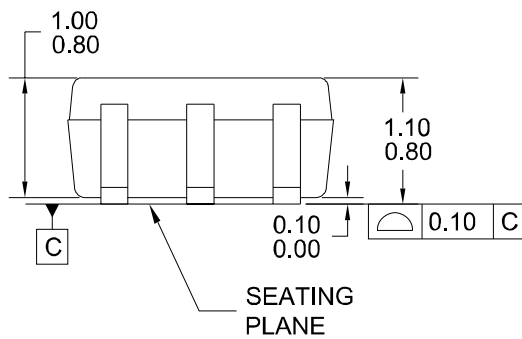
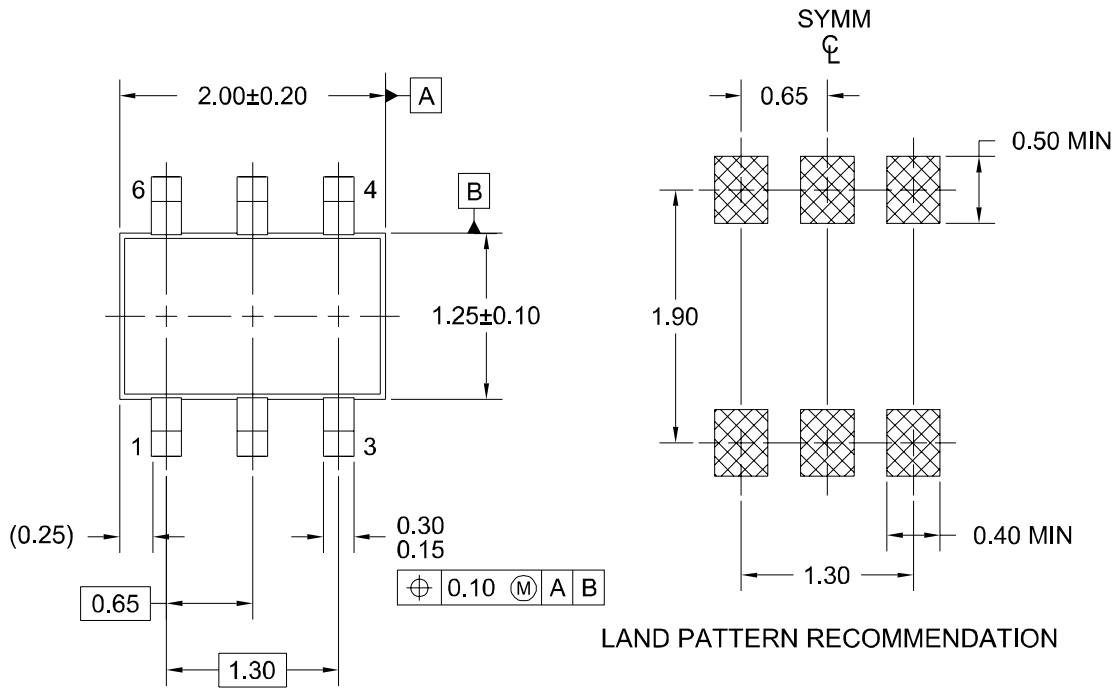
**Figure 9. Channel OFF Capacitance**



**Figure 10. Channel ON Capacitance**

## Physical Dimensions

Dimensions are in inches (millimeters) unless otherwise noted.



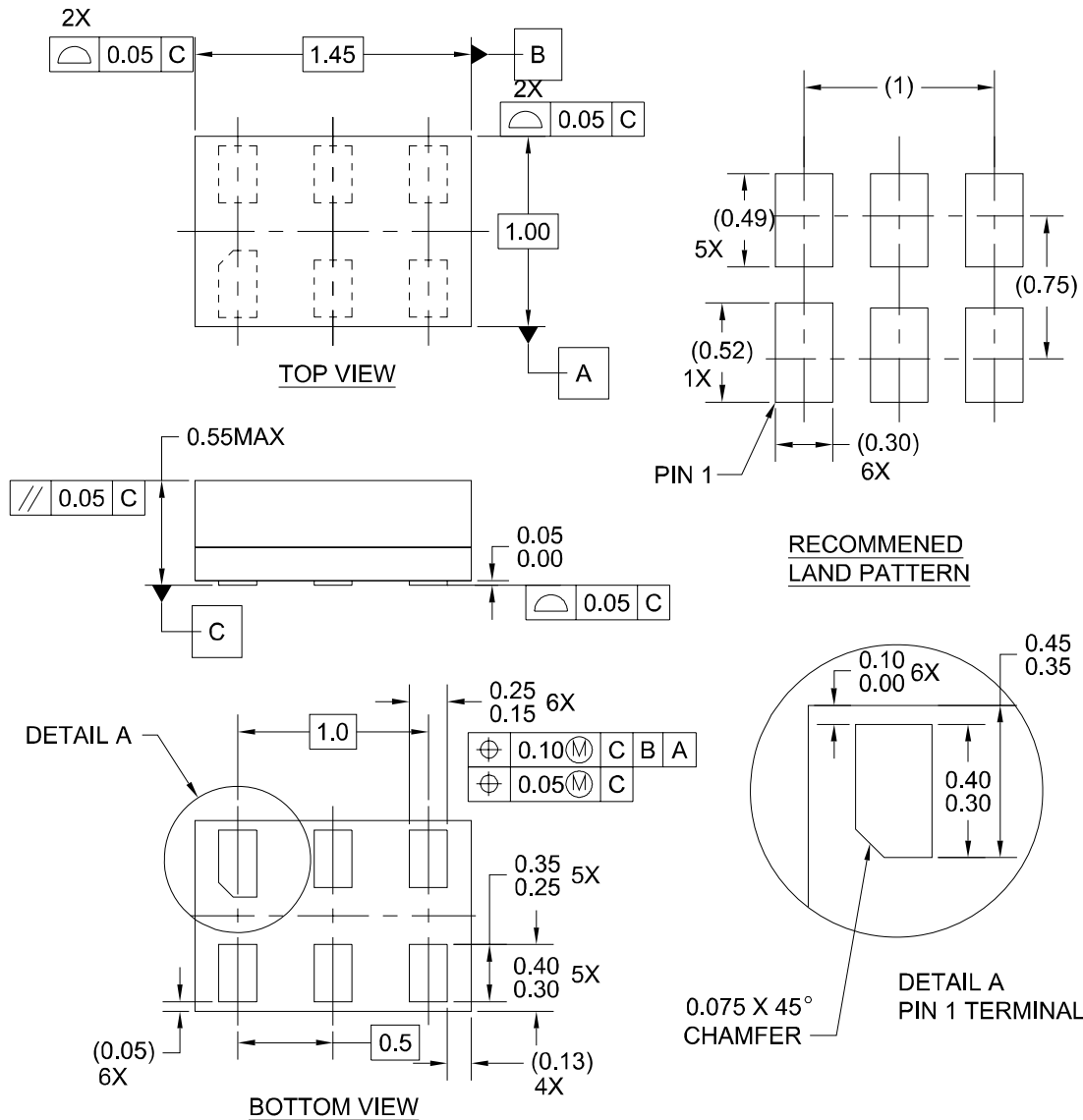
NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO EIAJ SC-88A, 1996.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH.

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### Physical Dimensions (Continued)

Dimensions are in inches (millimeters) unless otherwise noted.



**Notes:**

1. CONFORMS TO JEDEC STANDARD M0-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-1994

MAC06AREVC



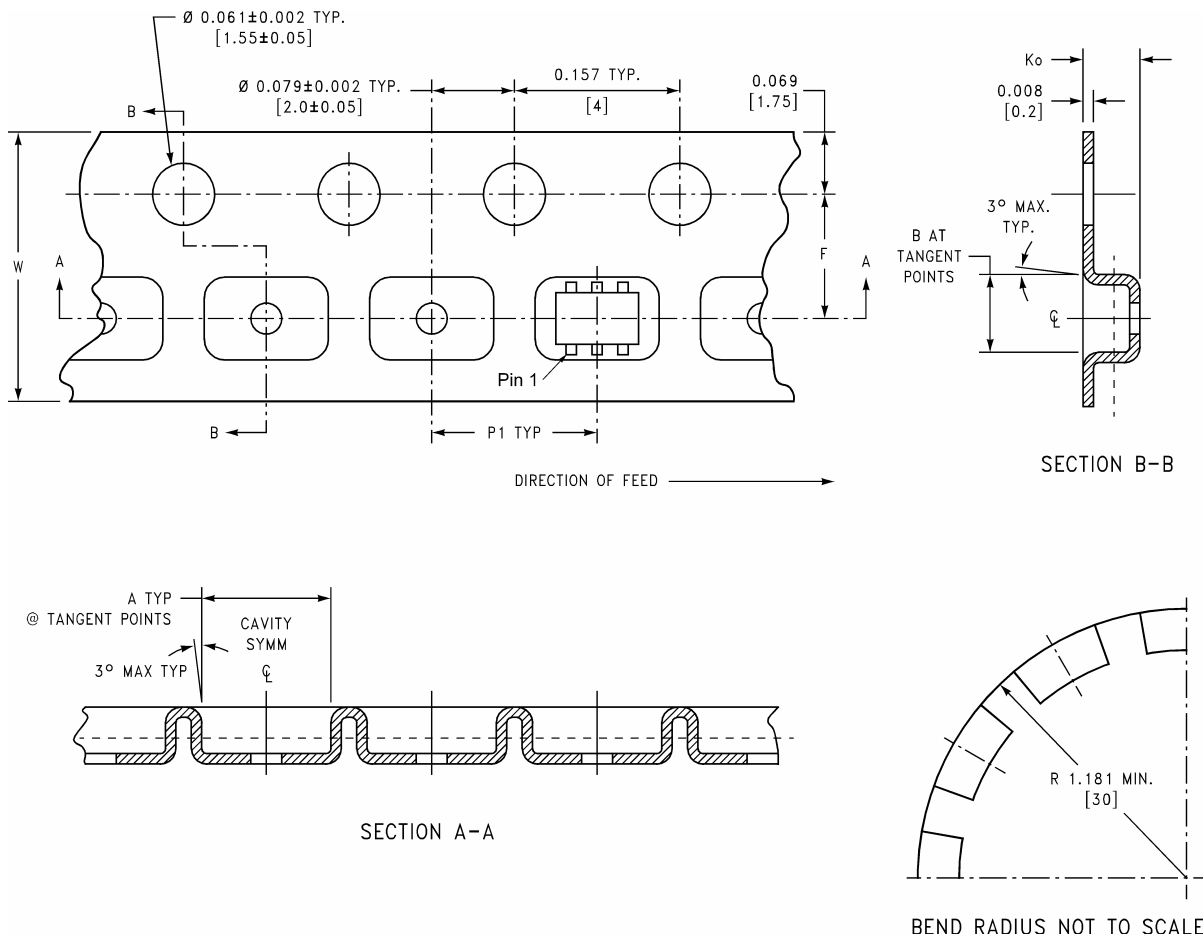
## Tape and Reel Specification

### Tape Format for SC70

Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
P6X	Leader (Start End)	125 (typ.)	Empty	Sealed
	Carrier	3000	Filled	Sealed
	Trailer (Hub End)	75 (typ.)	Empty	Sealed

### Tape Dimensions

Dimensions are in inches (millimeters).



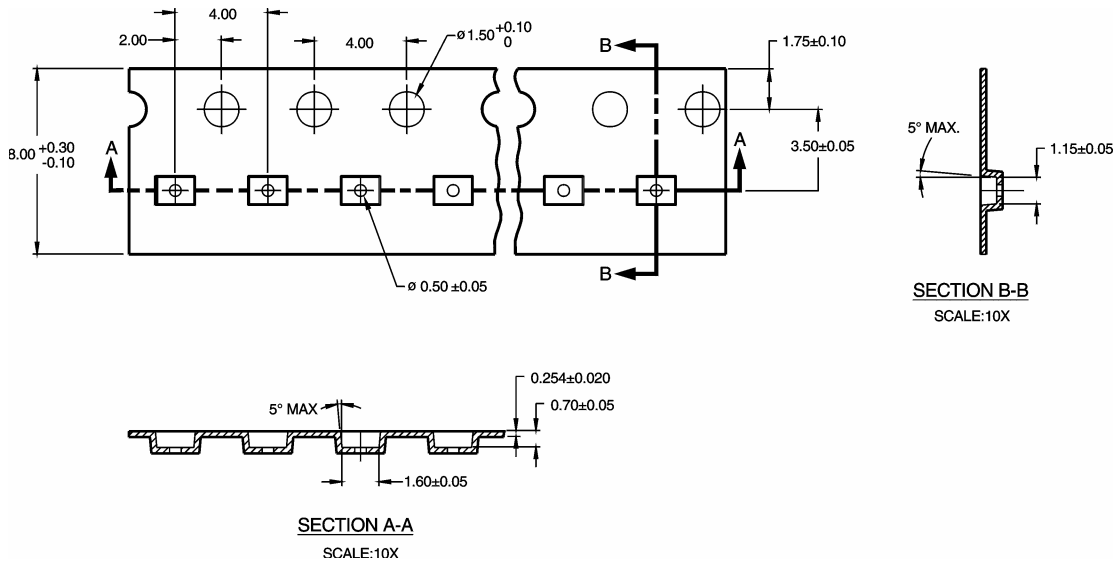
Package	Tape Size	DIM A	DIM B	DIM F	DIM K <sub>o</sub>	DIMP1	DIM W
SC70-6	8mm	0.093 (2.35)	0.096 (2.45)	0.138 ± 0.004 (3.5 ± 0.10)	0.053 ± 0.004 (1.35 ± 0.10)	0.157 (4)	0.315 ± 0.004 (8 ± 0.1)

### Tape Format for MicroPak

Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
L6X	Leader (Start End)	125 (typ.)	Empty	Sealed
	Carrier	5000	Filled	Sealed
	Trailer (Hub End)	75 (typ.)	Empty	Sealed

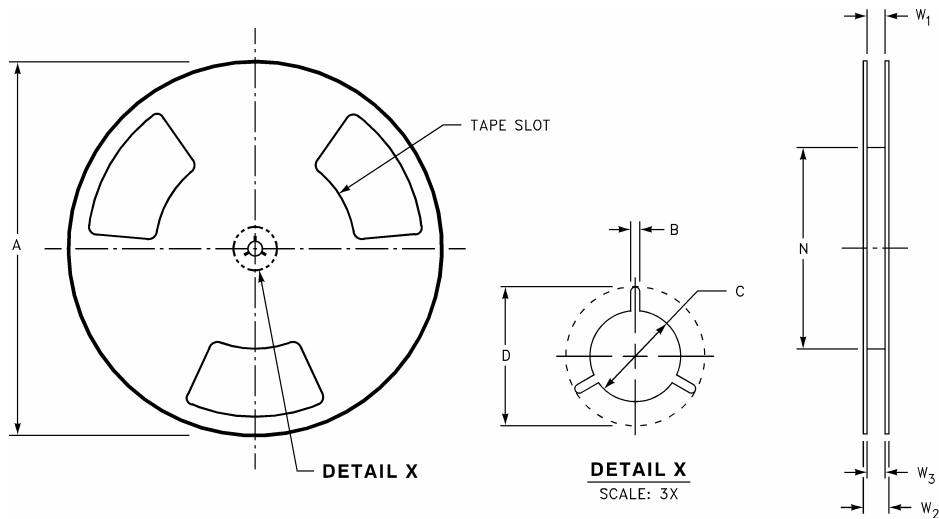
### Tape Dimensions

Dimensions are in inches (millimeters).



### Reel Dimensions

Dimensions are in inches (millimeters).



Tape Size	A	B	C	D	N	W1	W2	W23
8mm	7.0 (177.8)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	.0331 +0.059 / -0.000 (8.40 +1.50 / -0.00)	0.567 (14.40)	W1 +0.078 / -0.039 (W1 +2.00 / -1.00)

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ActiveArray <sup>™</sup>	FAST <sup>r</sup> <sup>™</sup>	LittleFET <sup>™</sup>	PowerSaver <sup>™</sup>	SuperSOT <sup>™</sup> -3
Bottomless <sup>™</sup>	FPS <sup>™</sup>	MICROCOUPLER <sup>™</sup>	PowerTrench <sup>®</sup>	SuperSOT <sup>™</sup> -6
Build it Now <sup>™</sup>	FRFET <sup>™</sup>	MicroFET <sup>™</sup>	QFET <sup>®</sup>	SuperSOT <sup>™</sup> -8
CoolFET <sup>™</sup>	GlobalOptoisolator <sup>™</sup>	MicroPak <sup>™</sup>	QST <sup>™</sup>	SyncFET <sup>™</sup>
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EcoSPARK <sup>™</sup>	I <sup>2</sup> C <sup>™</sup>	MSXPro <sup>™</sup>	RapidConfigure <sup>™</sup>	TINYOPTO <sup>™</sup>
E <sup>2</sup> CMOS <sup>™</sup>	i-Lo <sup>™</sup>	OCX <sup>™</sup>	RapidConnect <sup>™</sup>	TruTranslation <sup>™</sup>
EnSigna <sup>™</sup>	ImpliedDisconnect <sup>™</sup>	OCXPro <sup>™</sup>	μSerDes <sup>™</sup>	UHC <sup>™</sup>
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Across the board. Around the world. <sup>™</sup>		PACMAN <sup>™</sup>	SMART START <sup>™</sup>	VCX <sup>™</sup>
The Power Franchise <sup>®</sup>		POP <sup>™</sup>	SPM <sup>™</sup>	Wire <sup>™</sup>
Programmable Active Droop <sup>™</sup>		Power247 <sup>™</sup>	Stealth <sup>™</sup>	

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.

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